CLAIMS

What is claimed is:

1. A method of reverse link rate control at a mobile station comprising:

determining targeted queuing delays for reverse link transmit data;

monitoring transmit data queue sizes and reverse link throughput; and

generating reverse link rate requests based on the transmit data queue sizes, the reverse link throughput, and the targeted queuing delays.

2. The method of claim 1, wherein determining targeted queuing delays for reverse link transmit data comprises determining a targeted queuing delay for each service instance being supported by the mobile station.

3. The method of claim 2, wherein monitoring transmit data queue sizes and reverse link throughput comprises monitoring a transmit data queue size and a reverse link throughput for each service instance.

4. The method of claim 3, wherein generating reverse link rate requests based on the transmit data queue sizes, the reverse link throughput, and the targeted queuing delays comprises determining whether an expected queuing delay of any service instance exceeds a target queuing delay for that service instance and, if so, requesting a reverse link rate increase.

5. The method of claim 3, wherein generating reverse link rate requests based on the transmit data queue sizes, the reverse link throughput, and the targeted queuing delays comprises determining whether expected queuing delays for all service instances are below target queuing delays defined for the service instances and, if so, requesting a reverse link rate decrease.

6. The method of claim 2, wherein determining a targeted queuing delay for each service instance being supported by the mobile station comprises receiving service instance delay requirements from a wireless communication network supporting the mobile station.

7. The method of claim 1, wherein generating reverse link rate requests based on the transmit data queue sizes, the reverse link throughput, and the targeted queuing delays comprises generating reverse link rate requests on an event-triggered basis by comparing expected queuing delays for each of one or more service instances to targeted queuing delays associated with those service instances.

8. The method of claim 1, wherein generating reverse link rate requests based on the transmit data queue sizes, the reverse link throughput, and the targeted queuing delays comprises generating reverse link rate requests on a periodic basis to control an average queuing delay of the mobile station relative to a targeted queuing delay.

9. The method of claim 1, wherein generating reverse link rate requests based on the transmit data queue sizes, the reverse link throughput, and the targeted queuing delays comprises generating periodic rate requests based on, in each rate control period, determining a data rate needed substantially to meet targeted queuing delays in the next rate control period for each service instance being supported by the mobile station.

10. The method of claim 9, wherein determining a data rate needed substantially to meet targeted queuing delays in the next rate control period for each service instance being supported by the mobile station comprises:

for each service instance, computing a data rate required to meet the targeted queuing delay for that service instance in the next rate control period; and

calculating an aggregate data rate based on the data rates computed for the service instances being supported by the mobile station.

11. The method of claim 10, further comprising selecting one among a set of defined data rates based on the calculated aggregate data rate, and requesting the selected one of the defined data rates for the next rate control period.

12. The method of claim 1, wherein generating reverse link rate requests based on the transmit data queue sizes, the reverse link throughput, and the targeted queuing delays comprises determining a required data rate that satisfies a targeted queuing delay for reverse link data transmissions over a given interval, calculating an effective data rate from the required data rate that can be achieved using one or more combinations of defined data rates, and requesting the effective data rate.

13. A method of reverse link rate control at a mobile station comprising:

receiving targeted queuing delay information for one or more service instances being supported by the mobile station;

periodically calculating an expected queuing delay for each service instance;

requesting a reverse link rate increase if any expected queuing delay exceeds a first delay value based on a targeted delay for the corresponding service instance; and

requesting a reverse link rate decrease if the expected queuing delay for each service instance falls below a second delay value based on the targeted delay for the service instance.

14. The method of claim 13, further comprising computing the first delay value for each service instance by scaling the targeted delay for that service instance by a first factor and computing the second delay value for each service instance by scaling the targeted delay for that service instance by a second factor.

15. The method of claim 14, further comprising setting at least one of the first and second factors based on a granularity of defined rate change steps.

16. The method of claim 14, further comprising setting at least one of the first and second factors based on a subscriber class association of the mobile station.

17. The method of claim 14, further comprising adjusting a rate control interval for periodically calculating the expected queuing delay for each service instance based on whether a requested reverse link rate increase or decrease was granted.

18. The method of claim 13, wherein periodically calculating an expected queuing delay for each service instance comprises, for each service instance, calculating an expected queuing delay for one or more Radio Link Protocol (RLP) frames to be transmitted based on an average transmit data throughput for that service instance, and a current queue size for that service instance.

19. The method of claim 18, further comprising tracking an average transmit data throughput for each service instance.

20. A method of reverse link rate control at a mobile station comprising:

receiving targeted queuing delay information for one or more service instances being supported by the mobile station; and

periodically calculating an overall data rate required to achieve targeted queuing delays for the service instances and requesting a rate change based on the overall data rate.

21. The method of claim 20, wherein periodically calculating an overall data rate required to achieve targeted queuing delays for the service instances comprises:

calculating a required data rate for each service instance needed to achieve the targeted queuing delay for that service instance in a next rate control period; and

calculating the overall data rate based on the required data rates of the service instances.

22. The method of claim 20, wherein requesting a rate change based on the overall data rate comprises requesting one in a set of defined data rates that will allow the mobile station to achieve the targeted queuing delays for the service instances.

23. The method of claim 20, wherein requesting a rate change based on the overall data rate comprises selecting an effective data rate based on the overall data rate, wherein the effective data rate represents one or more combinations of defined data rates and corresponding transmit intervals.

24. A mobile station for use in a wireless communication network comprising:

a receiver circuit to receive signals transmitted by the network;

a transmitter circuit to transmit signals, including rate requests, to the network; and

a rate controller circuit configured to:

determine targeted queuing delays for reverse link transmit data;

monitor transmit data queue sizes and reverse link throughput at the mobile station; and

generate reverse link rate requests based on the transmit data queue sizes, the reverse link throughput, and the targeted queuing delays.

25. The mobile station of claim 24, wherein the rate controller circuit is configured to determine targeted queuing delays for reverse link transmit data by determining a targeted queuing delay for each service instance being supported by the mobile station.

26. The mobile station of claim 25, wherein the rate controller circuit is configured to monitor transmit data queue sizes and reverse link throughput at the mobile station by monitoring a transmit data queue size and a reverse link throughput for each service instance.

27. The mobile station of claim 26, wherein the rate controller circuit is configured to generate reverse link rate requests based on the transmit data queue sizes, the reverse link throughput, and the targeted queuing delays by determining whether an expected queuing delay of any service instance exceeds a target queuing delay for that service instance and, if so, requesting a reverse link rate increase.

28. The mobile station of claim 26, wherein the rate controller circuit is configured to generate reverse link rate requests based on the transmit data queue sizes, the reverse link throughput, and

the targeted queuing delays by determining whether expected queuing delays for all service instances are below target queuing delays defined for the service instances and, if so, requesting a reverse link rate decrease.

29. The mobile station of claim 25, wherein the rate controller circuit is configured to determine a targeted queuing delay for each service instance being supported by the mobile station by receiving service instance delay requirements from a wireless communication network supporting the mobile station.

30. The mobile station of claim 24, wherein the rate controller circuit is configured to generate reverse link rate requests based on the transmit data queue sizes, the reverse link throughput, and the targeted queuing delays by generating reverse link rate requests on an event-triggered basis by comparing expected queuing delays for each of one or more service instances to targeted queuing delays associated with those service instances.

31. The mobile station of claim 24, wherein the rate controller circuit is configured to generate reverse link rate requests based on the transmit data queue sizes, the reverse link throughput, and the targeted queuing delays by generating reverse link rate requests on a periodic basis to control an average queuing delay of the mobile station relative to a targeted queuing delay.

32. The mobile station of claim 24, wherein the rate controller circuit is configured to generate reverse link rate requests based on the transmit data queue sizes, the reverse link throughput, and the targeted queuing delays by generating periodic rate requests based on, in each rate control period, determining a data rate needed substantially to meet targeted queuing delays in the next rate control period for each service instance being supported by the mobile station.

33. The mobile station of claim 32, wherein the rate controller circuit is configured to determine a data rate needed substantially to meet targeted queuing delays in the next rate control period for each service instance being supported by the mobile station by:

for each service instance, computing a data rate required to meet the targeted queuing delay for that service instance in the next rate control period; and

calculating an aggregate data rate based on the data rates computed for the service instances being supported by the mobile station.

34. The mobile station of claim 33, wherein the rate controller circuit is configured to select one among a set of defined data rates based on the calculated aggregate data rate, and request the selected one of the defined data rates for the next rate control period.

35. The mobile station of claim 24, wherein the rate controller circuit is configured to generate reverse link rate requests based on the transmit data queue sizes, the reverse link throughput, and the targeted queuing delays by determining a required data rate that satisfies a targeted queuing delay for reverse link data transmissions over a given interval, calculating an effective data rate from the required data rate that can be achieved using one or more combinations of defined data rates, and requesting the effective data rate.

36. A method of forward link control at a radio base station comprising:

determining targeted queuing delays for one or more data connections being used to serve a plurality of mobile stations on one or more forward link communication channels;

determining expected queuing delays for the data connections by monitoring transmit data queue sizes and forward link throughput for the data connections; and

adjusting at least one of a scheduling priority and a forward link data rate for a given data connection based on the expected and targeted queuing delays.

37. The method of claim 36, wherein the one or more data connections are supported on a shared forward link communication channel that serves the plurality of mobile stations, and wherein adjusting at least one of a scheduling priority and a forward link data rate for a given data connection based on the expected and targeted queuing delays comprises adjusting the scheduling priority of one or more data connections over one or more scheduling intervals responsive to determining that the expected queuing delays exceed the targeted queuing delays.

38. The method of claim 36, wherein adjusting at least one of a scheduling priority and a forward link data rate for a given data connection based on the expected and targeted queuing delays comprises in a given forward link service interval, adjusting the forward link data rate for the given connection responsive to determining that the expected queuing delay exceeds the targeted queuing delay.

39. The method of claim 36, wherein adjusting at least one of a scheduling priority and a forward link data rate for a given data connection based on the expected and targeted queuing delays comprises configuring scheduling utility functions used to determine the scheduling priorities of the data connections to be dependent on the expected queuing delays.

40. The method of claim 39, wherein configuring scheduling utility functions used to determine the scheduling priorities of the data connections to be dependent on the expected queuing delays comprises configuring the scheduling utility function of each data connection such that its priority increases if the expected queuing delay exceeds the targeted queuing delay of the data connection.

41. The method of claim 36, wherein determining targeted queuing delays for one or more data connections being used to serve a plurality of mobile stations on one or more forward link communication channels comprises determining Quality-of-Service requirements associated with each data connection.

42. A base station for use in a wireless communication network comprising:

transmitter circuits to transmit signals to a plurality of mobile stations;

receiver circuits to receive signals from a plurality of mobile stations; and

processing circuits, including a rate control processor, to determine whether to deny or grant rate adjustment requests received from one or more mobile stations and to grant non-standard rate requests by mapping each non-standard rate request into a standard set of rates based on selecting one or more combinations of the standard rates.

43. The base station of claim 42, wherein mapping each non-standard rate request into a standard set of rates based on selecting one or more combinations of the standard rates comprises selecting at least a first standard rate to be used by a requesting mobile station for a first number of transmit intervals and a second standard rate to be used by the requesting mobile station for a second number of transmit intervals.

44. The base station of claim 42, wherein mapping each non-standard rate request into a standard set of rates based on selecting one or more combinations of the standard rates comprises selecting two or more standard rates to be used by a requesting mobile station over one or more defined transmit intervals such that an effective rate achieved by the requesting mobile station over the one or more defined transmit intervals substantially equals the non-standard rate requested by the requesting mobile station.